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(54) **Apparatus for drying a fibre web, and a drying section of a paper machine**

Vorrichtung zur Trockung einer Faserbahn und Trockenplatte einer Papiermaschine

Appareil pour le séchage d'une bande fibreuse et section de séchage d'une machine à papier

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Description

[0001] The invention relates to an apparatus for drying a fibre web, the apparatus comprising two endless bands that are impermeable to air; first turning rolls, around which the first band is arranged to run; and second turning rolls, around which the second band is arranged to run; the first and second bands being arranged to run part of the way in parallel such that they define between them a drying zone where at least the first band is cooled and where a heating element is arranged; the fibre web and at least one auxiliary wire being conducted through the drying zone such that the fibre web is in contact with the heating element and the auxiliary wire is in contact with the cooled band.

[0002] The invention also relates to a drying section of a paper machine, especially a fine paper machine, the drying section comprising two endless bands that are impermeable to air; first turning rolls, around which the first band is arranged to run; and second turning rolls, around which the second band is arranged to run; the first and second bands being arranged to run part of the way in parallel such that they define between them a drying zone where at least the first band is cooled; a fibre web and at least one auxiliary wire being conducted through the drying zone such that the auxiliary wire is in contact with the cooled band and the fibre web is heated to evaporate the water therefrom.

[0003] Drying of a fibre web between two parallel metal bands moving in the same direction such that the fibre web is in contact with a heated metal band and that there is a felt between the fibre web and a second, cooled metal band, whereby the steam removed from the fibre web by heating condenses onto the felt by the effect of the cold metal band, is previously known from many patent publications, such as Finnish Patent 78,755 (corresponding to EP-A-0 326 348). The operation is based on the idea that two endless metal bands are arranged to run around the turning rolls, and that against the surface that remains inside the resultant loops there are pressure chambers containing hot steam and water, respectively, such that the pressure produced presses the hot and cold bands against the fibre web and felt located between them. Together with seals, the bands located between the pressure chambers provide one side for the pressure chambers such that the steam and water can directly affect the bands. The operation of the apparatus has been disclosed e.g. in the above patent publication.

[0004] Further, Finnish Patent 78,755 (corresponding to EP-A-0 326 348) discloses an apparatus for drying a fibre web. In the apparatus, air is first removed from the web and the drying felt, which are then conducted between two parallel metal bands that move at the same rate as the web and the felt. To effect the drying process, the band that is on the side of the web is heated with a heating apparatus before the band enters the drying zone, and the band that is on the side of the drying felt is cooled before the band enters the drying zone and comes into contact with the drying felt.

[0005] The drawback of the above apparatuses for drying a fibre web is the fatigue of the metal belts used as the hot and the cold band under cyclic load, which is also partly due to detrimental chemicals, e.g. thiosulphides or chlorides, that may be present in the web and that reduce the fatigue resistance of stainless steel. Further, since the drying conditions are not exactly the same on both sides of the web, the two sides of the paper are not completely identical, either.

[0006] The object of the present invention is to provide a drying apparatus in which the above drawbacks are eliminated and which speeds the drying process.

[0007] The drying apparatus of the invention is characterized in that the heating element is a heated endless band that is permeable to steam and passes through the drying zone together with the fibre web and the auxiliary wire, the auxiliary wire being arranged between the heating element and the first, cooled band, so that the steam evaporating from the fibre web passes through the heating element and further through the auxiliary wire toward the first, cooled band, and condenses onto the surface of the first, cooled band.

[0008] The drying section of the paper machine according to the invention is also characterized in that both the bands that are impermeable to steam are cooled; that there are two auxiliary wires between them, both of which are in contact with one cooled band; and that between the auxiliary wires there are two bands, e.g. metal wires, that are permeable to steam, form an endless loop, have good thermal conductivity and pass through the drying zone, said bands being heated before the drying zone, and the fibre web that is in contact with said bands being taken between them through the drying zone, whereby the bands heat the water present in the fibre web, turning it into steam, and steam evaporating from the fibre web passes through said steam-permeable bands and further through the auxiliary wires toward the cooled bands and condenses onto the surface of the bands that is on the side of the auxiliary wires.

[0009] The essential idea of the invention is that the heating element heating a wet web is an endless band, such as a metal wire, that is permeable to steam, whereby the steam evaporating from the fibre web evaporates through the heating element and further through the auxiliary wire located on the other side of the heating element; and that steam then condenses onto that surface of the cooled band that is on the side of the auxiliary wire. Further, the essential idea of one embodiment is that one side of the fibre web is heated with the above steam-permeable heating element and the other side with another heating element. The essential idea of another embodiment is that both sides of the fibre web are heated with a similar steam-permeable heating element.

[0010] One advantage of the invention is that the heating element used can be a mechanically and chemically strong band, such a metal wire. Another advan-

tage of the invention is that identical drying conditions are provided on both sides of the fibre web, whereby the two sides of the paper produced will be identical after the drying process. Yet another advantage is that the invention speeds the drying process.

[0011] In the following, the invention will be described in greater detail with reference to the attached drawings, in which

fig. 1 shows a schematic sectional side view of one embodiment of the drying apparatus according to the invention in the travel direction of the web,
fig. 2 shows a schematic sectional side view of another embodiment of the drying apparatus according to the invention in the travel direction of the web, implemented as a drying section of a paper machine, and
fig. 3 shows a cross-sectional view of one detail of the apparatus according to fig. 2, the cross-section being taken along line B-B of fig. 2.

[0012] Fig. 1 shows a schematic sectional side view of one drying apparatus according to the invention in the travel direction of the web. The drying apparatus comprises a first band 1, or an upper band, and a second band 2, or a lower band, that are endless, are impermeable to air, have good thermal conductivity, and are made e.g. of metal or polymer material. The bands run part of the way in parallel, and a heating wire 3, an auxiliary wire or felt 4, and a fibre web 5 are arranged between those surfaces of the bands that face each other. The fibre web 5 runs between the lower band 2 and the heating wire 3. The upper surface of the heating wire 3 is here against the auxiliary wire 4, and the auxiliary wire, in turn, is against the upper band 1. The fibre web moves to the direction indicated by arrow A. The first band 1 is arranged to turn around first turning rolls 6a and 6b located at the ends of the drying apparatus. The second band 2, in turn, is arranged to turn around second turning rolls 7a and 7b which are located below turning rolls 6a and 6b at the ends of the drying apparatus. Wires 3 and 4 are supported and guided with guide rolls 8. For the sake of clarity, the support of wires 3 and 4 with the guide rolls 8 is presented in fig. 1 in a simplified form. The support and guidance of wires 3 and 4 are, as such, known from the prior art, and so they will not be discussed in greater detail herein. Since the pressure prevailing in the drying zone, in the space between bands 1 and 2, is usually different from the pressure prevailing outside or on the sides of bands 1 and 2, seals are arranged between bands 1 and 2, or close to their edges, on both sides of the apparatus, the seals preventing transfer of liquid or gas laterally from the space between bands 1 and 2, or vice versa. One example for a seal like this is shown in greater detail in fig. 3. Supporting members can be arranged in the drying zone to support the bands 1 and 2, the wires 3 and 4 and the fibre web 5 from below in a manner known per se. To generate the heat needed for the drying, a heating unit 11 is arranged to heat the heating wire 3. The heating wire 3 thus functions as the heating element of the drying apparatus. A cooling chamber 9 is arranged to cool the first band 1, the edges of the chamber comprising seals 9a with which the first band 1 is sealed relative to the cooling chamber 9. At the first band 1 is arranged a doctor blade 12, with which moisture condensed onto the first band 1 is removed from the surface of the band. At the auxiliary wire 4 is arranged a blow box 13a and a suction box 13b, which are used for removing moisture from the auxiliary wire 4. The auxiliary wire 4 may be either a plastic wire or a felt, the essential feature being that the auxiliary wire 4 can hold the condensed water formed by the moisture removed from the web.

[0013] The basis for the operation of the drying apparatus is that the heating wire 3, which is in contact with the web 5, is heated in the heating unit 11, whereby the heat of the heating wire 3 heats the water present in the web 5 so that it evaporates and passes through the heating wire 3 and the auxiliary wire 4 toward the first band 1. The first band 1, in turn, is continuously cooled by the cooling chamber 9 located above it, whereby the steam on its surface condenses into water and discharges with the auxiliary wire 4. The cooling chamber 9 may be essentially free of pressure or it may be pressurized, whereby the fibre web 5 can be subjected to the desired pressure in the direction of thickness by regulating the pressure in the cooling chamber 9. The pressure can also be controlled by regulating the temperature of the cooled band.

[0014] The drying process can be made increasingly effective by arranging a heating chamber 10 below the second band 2. The second band 2 is sealed relative to the heating chamber 10 with seals 10a. The second band 2 is then heated with a medium present in the heating chamber 10.

[0015] Before the fibre web 5, heating wire 3 and auxiliary wire 4 are conducted between the bands, they are conducted through an air exhaust unit 14, in which air is exhausted from the pores of the web 5 and the wires 3 and 4 as carefully as possible, e.g. by passing through them saturated steam of a suitable temperature, the steam pushing the air molecules away from the pores, replacing them with water molecules contained in the steam. Further, inside the air exhaust unit 14 can be arranged a so-called coanda box 15, which supports the fibre web 5 by means of the steam fed through said coanda box 15. One or more coanda boxes 15 can be arranged one after the other in the travel direction of the web 5. Since the air exhaust unit 14 and the coanda box 15 are, as such, known from the prior art, they will not be discussed in greater detail herein.

[0016] The heating wire 3 can be heated in the heating unit 11 e.g. by allowing the back-pressure steam to condense directly onto the surfaces of the heating wire 3 in some kind of a pressurized steam chamber through which the heating wire 3 passes via suitable apertures

provided with seals, and by removing the produced condensate from the surfaces of the heating wire 3 e.g. with superheated steam in the final step of the heating unit 11. Further, the heating wire 3 can be heated with hot gas using gas jets or burners. It is also possible to use IR radiators or induction heating, or some other heating method known per se.

[0017] To remove water from the auxiliary wire 4 after the drying step, it is possible to use both a blow box 13a and a suction box 13b, which are located on the opposite sides of the wire 4, or only one of them.

[0018] Fig. 2 shows a schematic sectional side view of another embodiment of the apparatus according to the invention in the travel direction of the web. It shows a drying section of a paper machine that is especially well-suited for the drying of fine printing papers, etc. The numbers used in fig. 2 correspond to those of fig. 1. In the apparatus of fig. 2, structures corresponding to those arranged above the fibre web 5 in fig. 1 are arranged on both sides of the fibre web 5. In fig. 2, the structures below the fibre web 5, which correspond to the structures above the fibre web 5 in fig. 1, are indicated by corresponding numbers as in fig 1, except that in fig. 2 the numbers are followed by an apostrophe (e. g. 3', 4'). The first band 1, for example, is thus cooled by cooling chamber 9, and the second band 2 is cooled by a corresponding cooling chamber 9'. The drying conditions on both sides of the fibre web 5 are then similar, i. e. moisture evaporates from the fibre web 5 both toward the first band 1 and toward the second band 2. On account of this, the fibre web 5 dries on both sides equally well, and so the two sides of the dried paper are identical after the drying. Further, the apparatus concerned speeds the drying process.

[0019] Fig. 3 shows a cross-sectional view of the edge of the drying zone, the cross-section being taken along line B-B of fig. 2. The reference numbers of fig. 3 correspond to those of figs. 1 and 2. The first band 1 and the second band 2 can be sealed with a seal 16, which bears against the upper surface of the first band 1 and the lower surface of the second band 2 in the manner shown in fig. 3. The seal 16 need not necessarily be in contact with bands 1 and 2. The steam inside the seal 16 can thereby exude from between the seal 16 and the bands 1 and 2. Further, other seals may be arranged between the first band 1 and the second band 2 in a manner known per se.

[0020] The drying apparatus according to the invention is particularly advantageous in the production of thin printing paper, but it can also be applied to the production of other kinds of paper. When e.g. 45-gram-newsprint is dried with the present drying apparatuses so that the dry matter content of the paper increases from 50% to 93% while the temperature in the heating element is 190°C, the maximum running rate used is 25 m/sec, the typical running rate being 20 m/sec. The required length of a drying section is then over 50 m. The apparatus according to the present invention makes it possible to increase the running rate to 40 m/sec, or, at a running rate of 25 m/sec, to shorten the drying section to 25 m. It is thus possible either to speed the process or to make the drying apparatus smaller, whereby the drying apparatus is cheaper to construct and requires less space.

[0021] The description and the drawings attached thereto are intended only to illustrate the idea of the invention. The drying apparatus according to the invention may vary in its details within the scope of the claims. It is thus not essential what medium is used in the heating and cooling chambers. For example, the medium in the cooling chamber 9 may be e.g. water or air, or some other suitable medium. Further, the medium in the heating chamber 10 may be e.g. steam, air or hot fuel combustion products.

[0022] The first 1 and second band 2 can also be cooled in some other way than by a cooling chamber. They can e.g. be cooled outside the drying zone. A separate pressure chamber that contains e.g. air can then be arranged to press the fibre web 5 in the direction of thickness. Also, the optional heating of the second band 2 can be carried out in some other way than by a heating chamber 10.

Claims

1. An apparatus for drying a fibre web, the apparatus comprising two endless bands (1, 2) that are impermeable to air; first turning rolls (6a, 6b), around which the first band (1) is arranged to run; and second turning rolls (7a, 7b), around which the second band (2) is arranged to run; the first (1) and second bands (2) being arranged to run part of the way in parallel such that they define between them a drying zone where at least the first band (1) is cooled and where a heating element (3) is arranged; the fibre web (5) and at least one auxiliary wire (4) being conducted through the drying zone such that the fibre web (5) is in contact with the heating element (3) and the auxiliary wire (4) is in contact with the cooled band (1), **characterized** in that the heating element is a heated endless band (3) that is permeable to steam and passes through the drying zone together with the fibre web (5) and the auxiliary wire (4), the auxiliary wire (4) being arranged between the heating element (3) and the first, cooled band (1), so that the steam evaporating from the fibre web (5) passes through the heated endless band (3) and further through the auxiliary wire (4) toward the first, cooled band (1), and condenses onto the surface of the first, cooled band (1).

2. A drying apparatus according to claim 1, **characterized** in that the second band (2) is also heated and that the fibre web (5) is in contact with the second, heated band (2).

3. A drying apparatus according to claim 1, **characterized** in that both the bands that are impermeable to steam are cooled, that an endless band that is permeable to steam and operates as a heating element is arranged on both sides of the fibre web (5), and that between the second heating element and the second cooled band (2) is arranged a second auxiliary wire (4'), whereby steam evaporating from the fibre web (5) passes through both heating elements and further through both auxiliary wires (4, 4') toward both the first cooled band (1) and the second cooled band (2), and whereby the steam condenses onto the surface of both the first cooled band (1) and the second cooled band (2).

4. A drying apparatus according to any one of the preceding claims, **characterized** in that the steam-permeable heating element is a heating wire (3) that is heated in a heating unit (11) before said heating wire (3) enters the drying zone.

5. A drying apparatus according to claim 4, **characterized** in that the heating wire (3) is a metal wire.

6. A drying section of a paper machine, especially a fine paper machine, the drying section comprising two endless bands (1, 2) that are impermeable to air; first turning rolls (6a, 6b), around which the first band (1) is arranged to run; and second turning rolls (7a, 7b), around which the second band is arranged to run (2); the first (1) and second bands (2) being arranged to run part of the way in parallel such that they define between them a drying zone where at least the first band (1) is cooled; a fibre web (5) and at least one auxiliary wire (4) being conducted through the drying zone such that the auxiliary wire (4) is in contact with the cooled band and the fibre web (5) is heated to evaporate the water therefrom, **characterized** in that both the bands (1, 2) that are impermeable to steam are cooled; that there are two auxiliary wires (4, 4') between them, both of which are in contact with one cooled band (1, 2); and that between the auxiliary wires (4, 4') there are two bands (3, 3'), e.g. metal wires, that are permeable to steam, form an endless loop, have good thermal conductivity and pass through the drying zone, said bands being heated before the drying zone, and the fibre web (5) that is in contact with said bands (3, 3') being taken between them through the drying zone, whereby the bands heat the water present in the fibre web (5), turning it into steam, and steam evaporating from the fibre web (5) passes through said steam-permeable bands (3, 3') and further through the auxiliary wires (4, 4') toward the cooled bands (1, 2) and condenses onto the surface of the bands that is on the side of the auxiliary wires (4, 4').

Patentansprüche

1. Vorrichtung zur Trocknung einer Faserbahn, wobei die Vorrichtung zwei Endlosbänder (1, 2), die luftundurchlässig sind; erste Schwenkwalzen (6a, 6b), um die das erste Band (1) laufen kann; und zweite Schwenkwalzen (7a, 7b) aufweist, um die das zweite Band (2) laufen kann; wobei die ersten (1) und zweiten Bänder (2) einen Teil des Wegs parallel derart laufen können, dass sie dazwischen eine Trokkenzone definieren, in der zumindest das erste Band (1) gekühlt wird und ein Heizelement (3) angeordnet ist; die Faserbahn (5) und zumindest ein Hilfssieb (4) derart durch die Trockenzone geführt werden, dass die Faserbahn (5) sich in Kontakt mit dem Heizelement (3) befindet und das Hilfssieb (4) sich in Kontakt mit dem gekühlten Band (1) befindet, **dadurch gekennzeichnet, dass** das Heizelement ein beheiztes Endlosband (3) ist, das dampfdurchlässig ist und zusammen mit der Faserbahn (5) und dem Hilfssieb (4) durch die Trockenzone geht, das Hilfssieb (4) zwischen dem Heizelement (3) und dem ersten gekühlten Band (1) angeordnet ist, so dass der von der Faserbahn (5) verdampfende Dampf durch das beheizte Endlosband (3) und weiter durch das Hilfssieb (4) in Richtung auf das erste gekühlte Band (1) geht und auf der Oberfläche des ersten gekühlten Bandes (1) kondensiert.

2. Trockenvorrichtung nach Anspruch 1, **dadurch gekennzeichnet, dass** das zweite Band (2) ebenso beheizt wird und sich die Faserbahn (5) in Kontakt mit dem zweiten beheizten Band (2) befindet.

3. Trockenvorrichtung nach Anspruch 1, **dadurch gekennzeichnet, dass** beide dampfundurchlässigen Bänder gekühlt werden, dass ein Endlosband, das dampfdurchlässig ist und als ein Heizelement arbeitet, an beiden Seiten der Faserbahn (5) angeordnet ist, und dass zwischen dem zweiten beheizten Element und dem zweiten gekühlten Band (2) ein zweites Hilfssieb (4') eingerichtet ist, wobei von der Faserbahn (5) verdampfender Dampf durch beide Heizelemente geht und weiter durch beide Hilfssiebe (4, 4') in Richtung auf sowohl das erste gekühlte Band (1) als auch das zweite gekühlte Band (2), und wobei der Dampf auf der Oberfläche von sowohl dem ersten gekühlten Band (1) als auch dem zweiten gekühlten Band (2) kondensiert.

4. Trockenvorrichtung nach einem der vorangegangen Ansprüche, **dadurch gekennzeichnet, dass** das dampfdurchlässige Heizelement ein Heizsieb (3) ist, das in einer Heizeinheit (11) erwärmt wird, bevor das Heizsieb (3) in die Trockenzone eintritt.

5. Trockenvorrichtung nach Anspruch 4, **dadurch gekennzeichnet, dass** das Heizsieb (3) ein Metall-

sieb ist.

6. Trockenpartie einer Papiermaschine, insbesondere einer Feinpapiermaschine, wobei die Trockenpartie zwei Endlosbänder (1, 2), die luftundurchlässig sind; erste Schwenkwalzen (6a, 6b), um die das erste Band (1) laufen kann; und zweite Schwenkwalzen (7a, 7b), um die das zweite Band (2) laufen kann; wobei die ersten (1) und zweiten Bänder (2) einen Teil des Wegs parallel derart verlaufen, dass sie dazwischen eine Trockenzone definieren, in der zumindest das erste Band (1) gekühlt wird; eine Faserbahn (5) und zumindest ein Hilfssieb (4) aufweist, die durch die Trockenzone derart geführt werden, dass das Hilfssieb (4) sich in Kontakt mit dem gekühlten Band befindet und die Faserbahn (5) erwärmt wird, um daraus das Wasser zu verdampfen, **dadurch gekennzeichnet, dass** beide dampfundurchlässigen Bänder (1, 2) gekühlt werden; dass zwei Hilfssiebe (4, 4') dazwischen vorhanden sind, wobei beide davon in Kontakt mit einem gekühlten Band (1, 2) sind; und dass zwischen den Hilfssieben (4, 4') zwei Bänder (3, 3'), beispielsweise Metallsiebe, die dampfdurchlässig sind, eine Endlosschleife bilden, gute Wärmeleitfähigkeit haben und durch die Trockenzone gehen, wobei die Bänder vor der Trockenzone erwärmt werden und die Faserbahn (5), die sich in Kontakt mit den Bändern (3, 3') befindet, zwischen diesen durch die Trockenzone getragen wird, wodurch die Bänder das in der Faserbahn (5) vorhandene Wasser erwärmen, es in Dampf verwandeln und der von der Faserbahn (5) verdampfende Dampf durch die dampfdurchlässigen Bänder (3, 3') und weiter durch die Hilfsbänder (4, 4') in Richtung auf die gekühlten Bänder (1, 2) geht und auf der Oberfläche der Bänder kondensiert, die sich an der Seite der Hilfssiebe (4, 4') befindet.

Revendications

1. Appareil pour le séchage d'une bande fibreuse, l'appareil comportant deux bandes sans fin (1, 2) qui sont imperméables à l'air, des premiers rouleaux rotatifs (6a, 6b), autour desquels la première bande (1) est agencée pour se déplacer, et des seconds rouleaux rotatifs (7a, 7b) autour desquels la seconde bande (2) est agencée pour se déplacer, la première bande (1) et la seconde bande (2) étant agencées pour se déplacer parallèlement sur une partie du trajet de telle sorte qu'elles définissent entre elles une zone de séchage où au moins la première bande (1) est refroidie et où un élément chauffant (3) est agencé, la bande fibreuse (5) et au moins une toile auxiliaire (4) étant amenées à travers la zone de séchage de sorte que la bande fibreuse (5) soit en contact avec l'élément chauffant (3) et que la toile auxiliaire (4) soit en contact avec la bande refroidie (1), caractérisé en ce que l'élément chauffant est une bande sans fin chauffée (3) qui est perméable à la vapeur et passe à travers la zone de séchage ensemble avec la bande fibreuse (5) et la toile auxiliaire (4), la toile auxiliaire (4) étant agencée entre l'élément chauffant (3) et la première bande refroidie (1), de sorte que la vapeur s'évaporant de la bande fibreuse (5) passe à travers la bande sans fin chauffée (3) et en outre à travers la toile auxiliaire (4) en direction de la première bande refroidie (1), et se condense sur la surface de la première bande refroidie (1).

2. Appareil de séchage selon la revendication 1, caractérisé en ce que la seconde bande (2) est également chauffée et que la bande fibreuse (5) est en contact avec la seconde bande chauffée (2).

3. Appareil de séchage selon la revendication 1, caractérisé en ce que les deux bandes qui sont imperméables à la vapeur sont refroidies, en ce qu'une bande sans fin qui est perméable à la vapeur et agit en tant qu'élément chauffant est agencée sur les deux côtés de la bande fibreuse (5), et en ce qu'entre le second élément chauffant et la seconde bande refroidie (2) est agencée une seconde toile auxiliaire (4'), de sorte que la vapeur s'évaporant de la bande fibreuse (5) passe à travers les deux éléments chauffants et en outre à travers les deux toiles auxiliaires (4, 4') en direction à la fois de la première bande refroidie (1) et de la seconde bande refroidie (2), et de sorte que la vapeur se condense sur la surface à la fois de la première bande refroidie (1) et de la seconde bande refroidie (2).

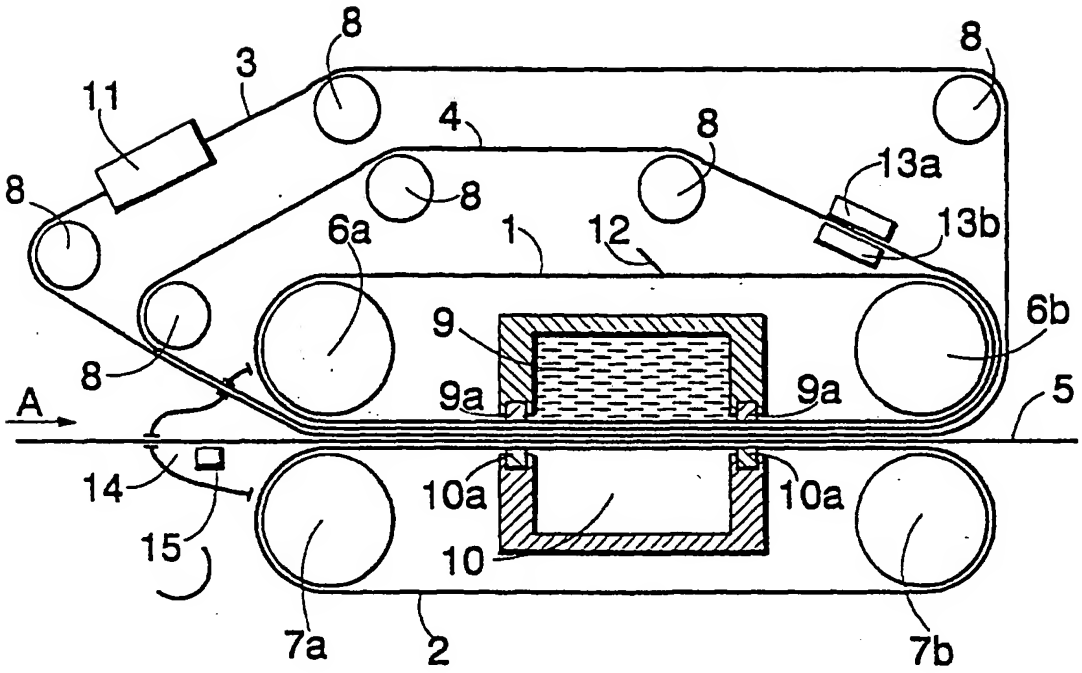
4. Appareil de séchage selon l'une quelconque des revendications précédentes, caractérisé en ce que l'élément chauffant perméable à la vapeur est une toile chauffante (3) qui est chauffée dans une unité de chauffage (11) avant que ladite toile chauffante (3) ne pénètre dans la zone de séchage.

5. Appareil de séchage selon la revendication 4, caractérisé en ce que la toile chauffante (3) est une toile métallique.

6. Tronçon de séchage d'une machine à papier, en particulier une machine à papier fin, le tronçon de séchage comportant deux bandes sans fin (1, 2) qui sont imperméables à l'air, des premiers rouleaux rotatifs (6a, 6b), autour desquels la première bande (1) est agencée pour se déplacer, et des seconds rouleaux rotatifs (7a, 7b), autour desquels la seconde bande (2) est agencée pour se déplacer, la première bande (1) et la seconde bande (2) étant agencées pour se déplacer parallèlement sur une partie du trajet de sorte qu'elles définissent entre elles une

zone de séchage où au moins la première bande est refroidie, une bande fibreuse (5) et au moins une toile auxiliaire (4) étant amenées à travers la zone de séchage de sorte que la toile auxiliaire (4) soit en contact avec la bande refroidie et la bande fibreuse (5) est chauffée pour évaporer la vapeur à partir de celle-ci, caractérisé en ce que les deux bandes (1, 2) qui sont imperméables à la vapeur sont refroidies, en ce qu'il existe deux toiles auxiliaires (4, 4') entre celles-ci, les deux étant en contact avec une bande refroidie (1, 2), et en ce qu'entre les toiles auxiliaires (4, 4') il existe deux bandes (3, 3') par exemple des toiles métalliques, qui sont perméables à la vapeur, forment une boucle sans fin, ont une bonne conductivité thermique et passent à travers la zone de séchage, lesdites bandes étant chauffées avant la zone de séchage, et la bande fibreuse (5) qui est en contact avec lesdites bandes (3, 3') est prise entre celles-ci à travers la zone de séchage, de sorte que les bandes chauffent l'eau présente dans la bande fibreuse (5), la transformant en vapeur, et la vapeur s'évaporant de la bande fibreuse (5) passe à travers lesdites bandes perméables à la vapeur (3, 3') et en outre à travers les toiles auxiliaires (4, 4') en direction des bandes refroidies (1, 2) et se condense sur la surface des bandes qui est située du côté des toiles auxiliaires (4, 4').

FIG. 1


8
3
11
8
4
8
8
13a
8
8
6a
1
12
13b
6b
9
8
9a
9a
A
5
14
10a
10a
15
10
7a
2
7b

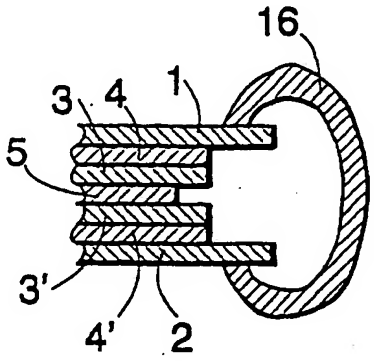

16
3
4
1
5
3'
4'
2

FIG. 3

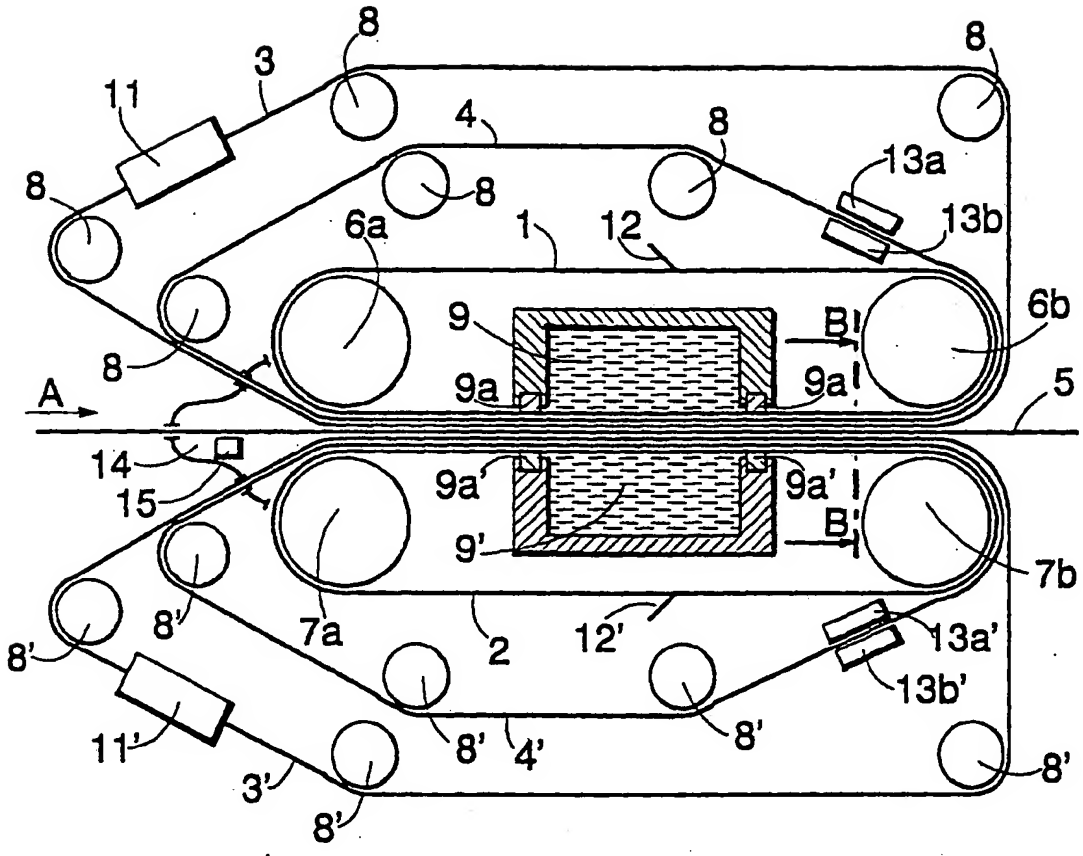

8
3
11
4
8
8
8
13a
8
8
13b
6a
1
12
9
B
6b
8
9a
9a
A
5
14
15
9a'
9a'
B
9'
7b
8'
8'
7a
2
12'
13a'
13b'
11'
8'
4'
8'
3'
8'
8'

FIG. 2